REMARKS

Claim Objections.

Claims 7-9 have been amended, as indicated and further as described below, to correct the antecedent basis problem caused by an inadvertent change in limitation terms "second circuit portion" and "first circuit portion" to "second circuit" and "first circuit", respectively.

Claim Rejections.

In view of the rejection of claims under 35 U.S.C. § 102(b) over Schwesig, claim 1 has been amended to better describe the novel features of the present invention.

Generally, claim 1 has been amended to now expressly recite:

(1) a "logic circuit" (that drives semiconductor switches in the high-power circuit) and which is separate from the "low power circuit" (now described as connecting the logic circuit to the high power circuit). In the preferred embodiment, the logic circuit is microprocessor 90 and the low power circuit is "tri-state buffer" 100 and its associated circuitry.

(2) claim a safety circuit electrically independent from the logic circuit. In the preferred embodiment, the safety circuit is a safety relay 110.

The cited prior art of Schwesig, like the present invention, addresses the problem of reliably disabling the operation of a motor drive without the need for high power contactors or the like physically disconnecting the motor from the drive. See generally paragraph 5 of the present invention.

Schwesig's approach receives a disable command at one of two microprocessors, S1 and S2, that in turn activate switches X1 and X2 to interrupt low voltage power to a set of opto couplers, OK1-OK6. The opto couplers connect to the drive power transistors. See Fig. 1 of Schwesig.

Similarly, the present invention receives a disable command to remove low voltage power to buffer 100 (and/or a set of pull-up resistors 104) which in turn block the communication of drive signals from a microprocessor to the drive transistors. See generally Fig. 1 of the present invention.

Unlike Schwesig, however, the present invention segregates the disable signal from the microprocessor, employing a safety circuit (safety relay) 110 wholly separate from the microprocessor 80, which develops the switching signals for the drive transistors. In this way, the correct processing of the disable signal is not exposed to what the inventors believe may be a potential unreliability inherent in the complexity of a microprocessor control as practiced by Schwesig.

In the preferred embodiment, the safety circuitry, is a well-characterized and reliable mechanical safety relay. While a safety relay is often used in safety circuits, its ratings are too low to directly disconnect a motor from a drive. The present invention, however, provides a way to use a safety relay in this context by connecting the safety relay to logic level signals normally internal to the drive.

Determining possible failure modes of a microprocessor which can not only experience hardware failure of any of millions of transistors, but also failure because of software errors, is difficult. In contrast, the safety relay is an established safety device whose simple construction and mechanical set of contacts are readily understood and analyzed, and which has been historically proven to provide reliable, verifiable operation. In a safety relay, normally closed contact 118 is mechanically coupled to a normally open contact 116 to provide for absolute indication of correct operation. The present invention allows a motor to be stopped in an emergency, with certainty, regardless of proper operation of the microprocessor.

This integration of a microprocessor independent safety circuit and, in particular, a safety relay, into the low level logic operation of the motor control, as now claimed, is believed to be both novel and non-obvious over the Schwesig reference. Accordingly, in light of the amendments to claim 1, it is believed that claim 1 is now allowable.

With respect to claim 3, Applicant believes that the signals SH1 or SH2 of Schwesig may be from a safety relay as proposed by the Examiner, but Schwesig teaches away from the present invention as now claimed by showing those signals received by the microprocessors S1 and S2, creating a problem intended to be avoided by the present invention of requiring the microprocessor that develops the drive signals to mediate the safety signals.

Claims 18-23 have been cancelled without prejudice to possible filing in a continuing application.

A new claim 24 providing limitations similar to those of claim 1 has been added to cover possible manufacture of the invention with a safety circuit such as a safety relay attached through terminals (shown in Fig. 1) to the low power circuit of the drive without being integrated into the drive.

In light of these remarks, it is believed that claim 1 and those claims dependent on claim 1 are allowable, and therefore allowance of claims 1-17 is hereby requested. The Examiner is encouraged to contact the undersigned directly at the telephone number provided below if there are minor issues or matters of form that need to be addressed.

Respectfully submitted,

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